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MICHIGAN

AGRICULTURAL EXPERIMENT STATION

STATE AGRICULTURAL COLLEGE.

CHEMICAL DEPARTMENT.

MICHIGAN SOILS.

CHEMICAL ANALYSIS OF

1. Wheat Lands,
2. Soils of Peach Belt,
3. Potato District,
4. Jack-Pine Plains,
5. Celery Soils,
6. Ceneral Purpose Soils.

BY R. C. KEDZIE.

The Bulletins of this Station will be sent free to all newspapers in the State, and to such individuals interested in farming as may request it. Address all applications to the Secretary, Agricultural College, Michigan.

MICHIGAN AGRICULTURAL EXPERIMENT STATION.

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THE SOILS OF MICHIGAN.

No state in the union has suffered more in reputation from false statements and ignorant misrepresentation than Michigan. At the time of its first settlement, to the popular apprehension the far-off and unknown Michigan was only, and would forever remain, the home of the wolf, the Indian and ague. By the white man it was uninhabited and uninhabitable. In a report made to a religious body in regard to the feasibility of establishing missionary stations in order to christianize this heathen wild, it was stated that the project was impracticable, "because only a narrow strip along the border of the territory was inhabitable, the interior being a vast and impenetrable swamp."

In his address at the laying of the corner stone of the new capitol in 1872, Hon. W. A. Howard made the following extract from the report of the surveyor general of Ohio, bearing date November 30, 1815: "The country on the Indian boundary line, from the mouth of the great Auglaize river and running thence for about fifty miles is (with few exceptions) low, wet land, with a very thick growth of underbrush, intermixed with very bad marshes, but generally very heavily timbered with beech, cottonwood, oak, etc.; thence continuing north and extending from the Indian boundary eastward, the number and extent of the swamps increase, with the addition of numbers of lakes from twenty chains to two or three miles across. Many of the lakes have extensive marshes adjoining their margins, sometimes thickly covered with a species of pine called tamarack, and other places covered with a coarse, high grass and uniformly covered from six inches to three feet (and more at times) with water. The margins of these lakes are not the only places where swamps are found, for they are interspersed throughout the whole country, and filled with water, as above stated, and varying in extent. The intermediate space between the swamps and lakes, which is probably near one-half of the country, is with a very few exceptions a poor, barren, sandy land, on which scarcely any vegetation grows, except very small scrubby oaks. In many places that part which may be called dry land is composed of little short sand hills, forming a kind of deep basins, the bottoms of many of which are composed of marsh, similar to the above described. The streams are generally narrow and very deep, compared with their width, the shores and bottoms of which are (with a very few exceptions) swampy beyond description; and it is with the utmost difficulty that a place can be found over which horses can be conveyed.

"A circumstance peculiar to that country is exhibited in many of the marshes by their being thinly covered with a sward of grass, by walking on which evinced the existence of water or a very thin mud immediately under their covering, which sinks from six to eighteen inches from the pressure of the foot at every step and at the same time rising before and behind the person passing over. The margins of many of the lakes and streams are in a simular situation and in many places literally afloat. On approaching the eastern part of the military lands towards the private claims on the straits and lake, the country does not contain so many swamps and lakes, but the extreme sterility and barrenness of the soil continues the same. Taking the country altogether, so far as has been explored and to all appearances, together with the information received concerning the balance, it is so bad there would not be more than one acre out of one hundred, if there would be one out of one thousand that would, in any case, admit of cultivation."

From the number of persons who have continued to decry Michigan in whole or in part it would seem that the surveyor general of Ohio had a large family. But as settlers poured into the new territory they were surprised and delighted to find, instead of impassable bogs and sterile sandhills, a region of wonderful beauty and fertility. Thus one county after another was rescued from the supposed dominion of chimeras dire, and pronounced to be the best farm lands on which the sun shines. But who shall say how many persons have been deterred by such ignorant and reckless assertions from making their home in the best state in our union? Sin drove the first pair from the primal Eden, but ignorance has barred out thousands of their children from many an earthly paradise.

GEOGRAPHICAL POSITION.

When we cast our eyes upon the map of our country we are struck with the unique position which our peninsula occupies in comparison with other lands in the same latitude and mark how Nature clasps with her protecting arm of *water* the "beautiful peninsula" and pours out the vast "unsalted seas" a rampart against the cold. Its geographical position and surroundings point it out as eminently fitted for productive industry, while its easily available water carriage will save it from the blighting influence of monopoly in transportation. The watered-stock of railways find more than a match in the water ways of our system of lakes, drowning out monopoly of transportation. Michigan is planted on the highway of nations—the highway of commerce that must last "as long as grass grows and water runs." Such a region must occupy a prominent position in the world's industries and commerce, unless these exceptional advantages are offset by unusual disabilities.

LUMBERING VS. FARMING.

The vast wealth of Michigan in lumber has so filled the public eye that it could not see the greater wealth of its soil. Men seemed to assume that the better it was for lumber the worse it must be for agriculture—as if a soil that could sustain such a wonderful forest growth must be incapable of growing anything but wood. As a consequence men seeking for new lands to make new homes have turned their back on rich soils, well watered lands, ready markets, available transportation, schools and churches, security and civilization to seek in the far west their resting place amid the alternate parching heat and deadly cold, and the wild disorder, discomfort and insecurity of border life. They reached for sunset and grasped a shadow. The great mass of these restless wanderers have rejected Michigan for a home because they were ignorant of this region—of its soil, productions, capabilities for cultivation, and it adaptedness to make desirable homes.

ANALYSIS OF MICHIGAN SOILS.

Desirous of obtaining reliable data for estimating the value of our soils, I sent out a circular fifteen years ago asking for representative soils from all the counties of the State, for chemical analysis, calling for soils that would be fairly representative of the locality, and not soils of exceptional quality. In response to this circular, thirty-one samples of soil were received, analyzed and the results of analysis published in the report of the State Board of Agriculture for 1878. Some attention was also directed to the physical properties of the soil, especially as related to water.

When chemistry was first applied to agriculture, it was supposed that the greatest benefit which chemistry could confer upon agriculture was to be derived from the analysis of the soil. The striking results which Sir Humphrey Davy obtained by analysis of a soil, barren from excess of the sulphate of iron, and the removal of the barrenness by adding lime to decompose the sulphate, confirmed the impression of the signal benefit to be derived from a chemical analysis of the soil. It was supposed that the fertility of any soil, the kind of crop it was fitted to raise, or the material which must be added to the soil to develop its greatest productiveness, were each and all to be determined simply by a chemical analysis of the soil. These extravagant expectations have not been realized. It was found that chemical analysis will not always distinguish between a fruitful and an unfruitful soil. A soil may be unproductive for physical reasons, though it may still contain all the chemical elements of fertility. The complete failure of Liebig's mineral theory of manures when put to the test of experience rang the knell of mere soil analysis.

But if chemical analysis failed when so much was demanded of it, we are not to go to the other extreme and conclude that because it is not good for so many things it is good for nothing. Chemical anlysis of the soil is of value in determining whether a soil is capable of fertility or the contrary; also in determining the measure of its possible fertility. There are certain ash elements which are absolutely necessary for plant growth, in the absence of any one of which vegetable growth is impossible; if the supply is relatively limited, plant growth will be limited correspondingly. If all the ash elements are present in sufficient amount and in available form, such soil is capable of fertility. Hence, chemical analysis of a soil is of importance in determining possibility of fertility and of the relative fertility which may be secured under favorable conditions.

CLASSIFICATION OF MICHIGAN SOILS.

No minute and technical classification of soils is attempted. The soils are classed rather for their agricultural uses than their chemical composition; the geographical position and climatic conditions in some cases affording a basis for classifying, e. g., the peach lands.

A word of explanation in regard to the meaning of the tables of analysis may be proper. To any one not familiar with agricultural chemistry, such tables will appear very dry and uninteresting, or even unintelligible. In these tables sand and silicates, alumina and oxide of iron make much the largest part of most soils. Everyone is familiar with sand; alumina is the basis of clay, and oxide of iron gives the brownish color to most soils. The great bulk of nearly all soils is made up of sand. clay and oxide of iron. Alumina is never found in the ash of cultivated plants; a certain amount of silica and oxide of iron is found in the ash of all plants; but the great mass of these materials as found in the soil is in large excess of the demands of the plant, and is of no worth in the chemistry of plant life; they are the mechanical agents of the soil, and are of worth mainly from their relations to temperature, moisture and the mechanical support of plants; their chief office in the soil is physical and not chemical, rendering the soil light or heavy, porous or retentive. The organic matter of the soil, besides furnishing a supply of combined nitrogen, is valuable for its physical relations to temperature, moisture and porosity of soils, and because it is an active agent in securing chemical changes in the soil, bringing the reserve elements of plant growth into active form.

The numbers attached to the following analyses refer to sample bottles of soils placed in the exhibit of the Experiment Station of the Michigan Agricultural College in the World's Fair, and to coresponding sample bottles in the Michigan State Exhibit in Agricultural Hall and one other set of such bottles at the Michigan Agricultural College. By referring to these sample bottles the reader can find the soils as well as learn their chemical composition.

I. *Wheat Lands. Nos. 1 to 9.*

A large part of the soils of Michigan are well fitted for the growth of winter wheat, and it might seem invidious to select any portion as wheat lands in particular, but the four southern tiers of counties are so specially adapted to this crop that they may be called the wheat belt.

No. 1.—River Rasin Bottoms, Deerfield, Lenawee, County.

Selected by Geo. H. Kedzie.
Forest Growth: Ash, Baswood, Hickory, Black Walnut, Oak, etc.
Soil cultivated forty years, without manure.

Sand and silicates	58.17
Alumina	6.48
Oxide of iron	7.62
Lime	1.98
Magnesia	1.43
Potash	1.84
Soda	1.20
Sulphuric acid	.32
Phosphoric acid	.40
Organic matter containing .42 Nitrogen	10.97
Water	9.45

Capillary capacity for water, 65.60

No. 2.—River Rasin Bottoms, Deerfield, Lenawee Co.

Selected by Geo H. Kedzie.
Virgin soil.
Timber: Ash, Basswood, Black Walnut, Oak, etc.

Sand and silicates	62.42
Alumina	10.64
Oxide of iron	3.46
Lime	2.10
Magnesia	1.59
Potash	2.05
Soda	1.19
Sulphuric acid	.24
Phosphoric acid	.41
Organic matter containing .37 Nitrogen	9.39
Water	6.08

Capillary capacity for water, 61.20

No. 3.—Burr Oak Wheat Lands, Saline, Washtenaw county.

Selected by J. S. Wood.
Timber: Burr Oak.

Sand and silicates	81.00
Alumina	5.23
Oxide of iron	4.66
Lime	1.28
Magnesia	.86
Potash	1.18
Soda	.19
Sulphuric acid	.42
Phosphoric acid	.40
Organic matter containing .11 nitrogen	2.98
Water	1.72

Capillary capacity for water, 36.30.

No. 4.—Prairie Soil, Volinia, Cass Co.

Selected by M. J. Gard.
Soil has been pastured but never cultivated.

Sand and silicates	63.77
Alumina	3.72
Oxide of iron	5.11
Lime	2.02
Magnesia	.66
Potash	1.18
Soda	.56
Sulphuric acid	.13
Phosphoric acid	.44
Organic matter containing .23 nitrogen	12.30
Water	10.19

Capillary capacity for water, 73.20.

No. 5.—Prairie Soil, Volinia, Cass Co.

Selected by M. J. Gard.
Soil has been cultivated for thirty years, has been plastered.

Sand and silicates	75.74
Alumina	4.20
Oxide of iron	5.46
Lime	1.38
Magnesia	.56
Potash	1.10
Soda	.43
Sulphuric acid	.18
Phosphoric acid	.33
Organic matter containing .21 nitrogen	7.50
Water	3.10

Capillary capacity for water, 50.55.

No. 6.—Bottom lands of Tittabawassee.

Selected by Geo. F. Ball.
Timber: Beech, maple, oak and basswood.

Sand and silicates	67.20
Alumina	6.31
Oxide of iron	7.91
Lime	1.64
Magnesia	1.23
Potash	1.85
Soda	1.15
Sulphuric acid	.30
Phosphoric acid	.49
Organic matter containing .22 nitrogen	7.48
Water	4.00

Capillary capacity for water, 51.40.

No. 7.—Garden Soil, Agricultural College.

Shlected by R. C. Kedzie.
Timber: Oak, beech, maple, elm, cherry and sassafras.

Sand and silicates	85 37
Alumina	4.53
Oxide of iron	1.81
Lime	1.22
Magnesia	.59
Potash	.85
Soda	.37
Sulphuric acid	.23
Phosphoric acid	.30
Organic matter containing .16 nitrogen	3.14
Water	1.55

Capillary capacity for water, 39.60.

No. 8.—Clay Soil from Vineyard Agricultural College.

Selected by R. C. Kedzie.
Timber: Oak, maple, beech and elm.

Sand and silicates	65.48
Alumina	15.60
Oxide of iron	6.40
Lime	1.28
Magnesia	.89
Potash	2.12
Soda	1.16
Sulphuric acid	.25
Phosphoric acid	.41
Organic matter containing .11 nitrogen	4.10
Water	2.28

Capillary capacity for water, 59.15.

No. 9.—Loamy soil from field No. 8, Agricultural College.

Selected by R. C. Kedzie.
Timber: Oak, beech and maple,

Sand and silicates	74.65
Alumina	9.66
Oxide of iron	4.18
Lime	1.46
Magnesia	.43
Potash	1.97
Soda	1.13
Sulphuric acid	.26
Phosphoric acid	.31
Organic matter containing .12 nitrogen	4.66
Water	1.25

Capillary capacity for water, 43.50.

II. *Peach Belt.*

The conditions that determine the successful cultivation of the peach in our State are climatic to a large extent. Yet the peach thrives best, and produces fruit of finest quality on light, porous soils which are found in abundance along the eastern shore of Lake Michigan. Yet fruit of good quality is produced on some of the heavy clay lands found in this belt.

No. 10.—Peach belt soil, South Haven VanBuren Co.

Selected by A. S. Dyckman.
Timber: Hemlock.

Sand and Silicates	87.23
Alumina	2.87
Oxide of Iron	1.52
Lime	.51
Magnesia	.46
Potash	.83
Soda	.34
Sulphuric Acid	.20
Phosphoric Acid	.13
Organic matter containing .07 nitrogen	3.41
Water	2.23

Capillary capacity for water, 44.70.

No. 11.—Soil from Chase, Lake Co.

Selected by J. Brown.
Timber: Maple, Elm, Hemlock, Basswood, etc.

Sand and Silicates	87.32
Alumina	3.22
Oxide of Iron	2.10
Lime	.62
Magnesia	.28
Potash	.90
Soda	.63
Sulphuric Acid	.10
Phosphoric Acaid	.23
Organic matter containing .12 Nitrogen	3.78
Water	.55

Capillary capacity for water, 45.55.

No. 12.—Soil from Eden, Mason Co.

Selected by C. E. Resseguie.
Timber: Hemlock, intermixed with Hard Wood.

Sand and Silicates	92.43
Alumina	2.99
Oxide of Iron	1.23
Lime	.66
Magnesia	.12
Potash	.65
Soda	.23
Sulphuric Acid	.10
Phosphoric Acid	.22
Organic matter containing .03 Nitrogen	.87
Water	.27

Capillary capacity for water, 32.40.

No. 13.—Sandy Loam, Eden, Mason Co.

Selected by C. E. Resseguie.
Timber: Hardwood, mixed with Hemlock.

Sand and Silicates	75.27
Alumina	6.93
Oxide of Iron	6.10
Lime	1.00
Magnesia	.89
Potash	2.10
Soda	.90
Sulphuric Acid	.27
Phosphoric Acid	.30
Organic matter containing .09 Nitrogen	3.30
Water	2.92

Capillary capacity for water, 42.85.

No. 14.—Soil From Evart, Osceola Co.

Selected by F. York.
Timber: Hardwood, mixed with Pine and Hemlock.

Sand and silicates	83.80
Alumina	5.10
Oxide of iron	3.24
Lime	.80
Magnesia	.64
Potash	1.19
Soda	.52
Sulphuric acid	.12
Phosphoric acid	.29
Organic matter containing .07 Nitrogen	3.06
Water	1.24

Capillary capacity for water, 45.80

No. 15.—Pine Land, Colfax, Mecosta Co

Selected by Fitch Phelps.
Timber: Heavy Pine Forest.

Sand and Silicates	75.54
Alumina	10.62
Oxide of iron	3.80
Lime	.94
Magnesia	.48
Potash	1.96
Soda	1.25
Sulphuric acid	.26
Phosphoric acid	.44
Organic matter csntaining .12 Nitrogen	2.97
Water	1.44

Capillary capacity for water, 45.40

No. 16.—Hardwood Lands, Big Rapids, Mecosta Co.

Selected by G. W. Warren.
Timber: Beech, Maple, Basswood.

Sand and silicates	76.00
Alumina	10.00
Oxide of iron	3.41
Lime	1.14
Magnesia	.49
Potash	1.80
Soda	1.16
Sulphuric acid	.24
Phosphoric acid	.33
Organic matter containing .10 Nitrogen	3.18
Water	1.90

Capillary capacity for water, 43.80.

No. 17.—Hardwood soil, Sherman, Wexford Co.

Selected by H. D. Griswold.
Timber: Maple, Rock-elm, Beech, Basswood and a little Hemlock.

Sand and silicates	86.74
Alumina	4.32
Oxide of iron	2.10
Lime	.65
Magnesia	.24
Potash	.83
Soda	.34
Sulphuric acid	.14
Phosphoric acid	.15
Organic matter containing .11 Nitrogen	3.26
Water	.86

Capillary capacity for water, 44.00.

No. 18.—Soil from Lake City, Missaukee Co.

Selected by L. A. Barker.
Timber: Beech, Maple, Elm and some Pine.

Sand and silicates	69.39
Alumina	8.35
Oxide of iron	5.80
Lime	1.15
Magnesia	.98
Potash	1.95
Soda	1.15
Sulphuric acid	.25
Phosphoric acid	.28
Organic matter, containing .11 nitrogen	4.73
Water	5.38

Capillary capacity for water, 39.10.

III. *The Potato District.*

Numbers 19 to 21 embrace several counties in the Traverse Bay region, where the soil is a sandy loam, rich in lime and potash. The fall of snow, caused by proximity to the lake, often comes before the ground is frozen, and root crops may be left in the ground all winter without injury. The porous nature of the soil, the abundance of lime and potash, and the climatic conditions all contribute to the production of potatoes of superior quality.

No. 19.—Potato Soil, Grand Traverse.

Selected by C. F. Davis,
Timber: Beech, Maple, Ash and Rock Elm.

Sand and silicates	88.65
Alumina	2.95
Oxide of iron	2.60
Lime	1.37
Magnesia	.41
Potash	.89
Soda	.32
Sulphuric acid	.14
Phosphoric acid	.13
Organic matter containing .04 nitrogen	2.05
Water	.49

Capillary capacity for water, 40.20.

No. 20.—Potato Soil, Benzonia, Benzie Co

Selected by C. L. Northrop.
Timber: Beech, Maple, Ash, Elm, Cherry, etc.

Sand and silicates	90.08
Alumina	2.86
Oxide of iron	1.50
Lime	.55
Magnesia	.27
Potash	1.10
Soda	.45
Sulphuric acid	.18
Phosphoric acid	.21
Organic matter containing .07 nitrogen	2.45
Water	.35

Capillary capacity for water, 39.30.

No. 21.—Potato Soil, Elk Rapids, Antrim Co.

Selected by Geo. E. Steele.
Timber: Maple, Basswood, Elm, Beech and some Hemlock.

Sand and silicates	84.68
Alumina	4.82
Oxide of iron	3.20
Lime	.95
Magnesia	.36
Potash	.98
Soda	.40
Sulphuric acid	.16
Phosphoric acid	.18
Organic matter containing .08 nitrogen	3.14
Water	.65

Capillary capacity for water, 52.10.

IV. *Jack-Pine Plains. Nos. 22 to 25.*

In the northern central portion of the lower peninsula is a large tract of light sandy lands which have been called jack-pine lands, the barrens, the plains, etc. It is a light, sandy soil, of a brownish color from the presence of oxide of iron, very porous, and little retentive power for water. The principal timber is *pinus banksiana* (jack-pine), scarlet oak, with scattering trees of Norway pine and white pine. The subsoil seldom has any hard pan, and the water line in the soil is usually from fifteen to thirty feet below the surface of the soil.

The annual fires which sweep over these plains burn up the yearly accumulation of vegetable matter, and the soil contains very little humus. The small lakes have an abundant deposit of marl of good quality.

Some experiments have been made to ascertain the possibility of the use of these lands for agricultural or grazing purposes, on the experimental farm at Grayling, Crawford county. Three specimens of soil from this experimental farm are offered for inspection and one of marl from a lake near by. By comparing No. 22, the soil in its natural condition, only fenced in and protected from fire for three years, with Nos. 23 and 24 which have been culitvated and enriched by plowing under the green crops raised without manure (green manuring,) the changes in the physical appearance and in chemical composition can be observed. The north field (No. 23) has raised successive crops of spurry, vetch and peas, which have been plowed under. The south field (No. 24) has raised successive crops of spurry, peas and red clover, all plowed under.

No. 22.—Virgin soil from the experimental farm at Grayling.

Sand and Silicates	94.97
Alumina	1.03
Oxide of iron	.86
Lime	.20
Magnesia	.12
Potash	.20
Soda	.90
Sulphuric acid	.06
Phosphoric acid	.05
Organic matter containing .02 Nitrogen	1.61
Water	.23

No. 23.—North field of the experimental farm at Grayling.

Sand and silicates	94.30
Alumina	.61
Oxide of iron	1.17
Lime	.24
Magnesia	.17
Potash	.33
Soda	.58
Sulphuric acid	.05
Phosphoric acid	.04
Organic matter containing .05 Nitrogen	2.50
Water	.20

No. 24.—South field of the experimental farm at Grayling.

Sand and silicates	95.02
Alumina	.49
Oxide of iron	.78
Lime	.32
Magnesia	.15
Potash	.30
Soda	.62
Sulphuric acid	.05
Phosphoric acid	.01
Organic matter containing .04 nitrogen	2.25
Water	.21

No. 25.—Marl from the lake, Grayling.

Sand and silicates	1.90
Alumina	.14
Oxide of iron	.10
Lime	45.16
Magnesia	.32
Potash	.37
Soda	2.65
Sulphuric acid	.56
Phosphoric acid	.01
Carbonic acid	43.10
Organic matter containing .20 nitrogen	5.69
Water	.64

V. *Soils for special crops: Muck lands adapted to the growth of celery, cranberries, peppermint, etc. Nos. 26 to 28.*

Of all our kinds of soil, swamp muck has been most conspicuously held up to public opprobium. Nothing good was said about it; nothing too bad could be said against it. Yet for certain kinds of crops it was found the best land in the world, and the fame of Michigan celery has gone into every state.

No one who has tasted Kalamazoo celery will forget its fine flavor, which has established its reputation far and wide. Many will look to the composition of the soil on which it is grown as the typical one for raising celery.

No. 26.—Michigan celery soils: Kalamazoo celery soil from Kalamazoo, Michigan.

Selected by J. Dunkley.

Sand and silicates	19.16
Alumina	1.40
Oxide of iron	3.94
Lime	6.09
Magnesia	.81
Potash	.34
Soda	.38
Sulphuric acid	1.31
Phosphoric acid	.88
Carbonic acid	1.95
Organic matter containing 2.53 nitrogen	63.76
Water	6.51

Grand Haven has also become a center for the production of this delicious and appetizing plant. The extensive deposits of muck near the mouth of Grand river afford a large field for this plant.

No. 27.—Michigan celery soils: Grand Haven celery soil from Grand Haven, Mich.

Selected by George Hancock.

Sand and silicates	24.09
Alumina	1.71
Oxide of iron	3.52
Lime	5.02
Magnesia	.62
Potash	.20
Soda	.33
Sulphuric acid	1.04
Phosphoric acid	.69
Carbonic acid	1.05
Organic matter containing 2.32 nitrogen	61.73
Water	10.85

But celery soils are not limited to the lower peninsula. A choice specimen of celery muck was received from the Newberry Celery & Improvement Co., at Newberry, Luce county. Superintendent H. L. Harris writes: "On this soil we have produced the finest celery grown in the State. The celery grown here has a fine nutty flavor unknown to the celery grown in the southern part of the State. The soil is from sixteen feet to unknown depth, and there are thousands of acres of the same character of soil in our vicinity. We would also say that during the eight years we have been growing celery here we have not had a failure of crop."

No. 28.—Michigan celery soils: Newberry celery soil from Newberry, Luce Co., Mich.

Selected by H. L. Harris, superintendent of the Newberry Celery and Improvement Company.

Sand and silicates	24.56
Alumina	2.21
Oxide of iron	1.30
Lime	4.18
Magnesia	.75
Potash	.42
Soda	.40
Sulphuric acid	.67
Phosphoric acid	.46
Carbonic acid	1.10
Organic matter containing 1.75 nitrogen	63.75
Water	7.31

A comparison of these celery soils brings out the fact that, except in the amount of sand and silicates, the composition shows a close similarity. The common supposition that oxide of iron is especially injurious in celery soils is not borne out by these analyses. Sulphate of iron is very injurious, and when more than one per cent is present no valuable crop will grow. A specimen of muck was sent here from Decatur which was barren from this cause.

PROPERTIES OF GOOD MUCK.

In the moist condition, all these kinds of muck have a deep brown-black color, the blacker the better; they are friable, easily breaking between the fingers, and are free from coarse, fibrous material; they have a pleasant earthy smell but no acid odor, and are entirely free from acid reaction. When moist muck of good quality is pressed against blue litmus paper so as to wet the paper, the blue color remains and no reddening takes place. Any muck that will redden blue litmus is unfit for cultivation while this acid condition remains. Sour muck is sorry material for cultivation. All the specimens of infertile muck that have been sent here for analysis—muck that would not grow weeds even—have been of this sour class and would turn blue litmus paper red very rapidly. By draining and weathering such soils by exposing to the action of frost, and especially by the application of lime, wood ashes, even leached ashes, the acid condition can be removed and these barren soils made to produce abundant crops of a certain class.

OTHER MUCK CROPS.

Celery is not the only plant that can be profitably raised on muck lands. Cranberry farms have been made on the mucky soil near St. Joseph and cranberries of superior quality produced. But success with this crop requires a soil free from acid; patches of sterile muck are often found in parts of cranberry fields, but in every instance the muck was sour.

Another crop distinctive of Michigan cultivation is the peppermint. The center of peppermint farming and distilling the oil seems to be in St. Joseph county. A request was made for a specimen of the muck that produced such large crops of the mint but none came. Another letter was sent which brought the following reply: "Yours of March 11th received. Your first communication was referred to ——— ———, of this town, who is the largest mint raiser in the State, and who promised me he would forward the soil desired, but I saw him this morning and he said the ground was so frozen that he could not get it without being to greater expense than he wished to incur. The facts are that he does not want published to the world the benefits of reclaiming marsh land, for that is all there is in it. Any marsh land that can be drained so that it can be worked and still hold enough moisture to carry the crop through is good enough mint soil. * * * I could go twenty rods from my store and get marsh soil and send you but it would not be essentially different from what you could get on the Agricultural farm."

My modest friend, the mint grower, had "oil in his vessel," but was unwilling to "let his light shine before men." However, a college student brought a specimen of the mint muck, but too late for analysis and mounting to exhibit at the World's Fair. It does not differ in appearance and properties from the Kalamazoo celery muck, No. 26.

VI. *General Purpose Soils. Nos. 29 to 38.*

This embraces a number of soils found in the central and northern counties of the State, which are of too miscellaneous a character to be placed in a more restricted classification. They are inserted to round out the list of Michigan soils that have been analyzed at this college.

No. 29.—Gilmore, Isabella Co.

Selected by P. H. Robins.
Timber: Hardwood.

Sand and silicates	88.13
Alumina	3.77
Oxide of iron	2.40
Lime	.87
Magnesia	.27
Potash	.86
Soda	.37
Sulphuric acid	.16
Phosphoric acid	.19
Organic matter containing .08 nitrogen	2.35
Water	.52

Capillary capacity for water, 49.60.

No. 30.—Midland, Midland Co.

Selected by Gee. F. Ball.
Timber: Beech, maple, oak and basswood.

Sand and silicates	67.20
Alumina	6.31
Oxide of iron	7.91
Lime	1.64
Magnesia	1.23
Potash	1.85
Soda	1.15
Sulphuric acid	.30
Phosphoric acid	.49
Organic matter containing .22 nitrogen	5.30
Water	2.10

Capillary capacity for water, 51.15.

No. 31.—Sheridan, Clare Co.

Selected by J. C. Rockafellow.
Timber: Pine, hemloch, birch and maple.

Sand and Silicates	93.31
Alumina	2.03
Oxide of iron	1.40
Lime	.36
Magnesia	.16
Potash	.54
Soda	.26
Sulphuric acid	.08
Phosphoric acid	.15
Organic matter containing .03 Nitrogen	1.34
Water	.37

Capillary capacity for water, 43.10.

No. 32.—Grant, Clare Co.

Selected by J. C. Rockafellow.
Timber: Maple, beech, basswood, ash, oak, etc.

Sand and silicates	71.45
Alumina	6.50
Oxide of iron	7.18
Lime	.99
Magnesia	.73
Potash	1.90
Soda	1.20
Sulphuric acid	.19
Phosphoric acid	.36
Organic matter containing .16 Nitrogen	5.90
Water	3.70

Capillary capacity for water, 44.90.

No. 33.—Webber, Lake Co.

Selected by George W. Townsend. "The Plains."

Sand and Silicates	92.48
Alumina	2.22
Oxide of iron	1.59
Lime	.35
Magnesia	.30
Potash	.73
Soda	.32
Sulphuric acid	.06
Phosphoric acid	.14
Organic matter containing .04 Nitrogen	1.22
Water	.40

Capillary capacity for water, 35.30.

No. 34.—St. Louis, Gratiot Co.

Selected by S. S. Hastings.
Timber: Pine, Beech, Soft Maple, Oak and Sassafras.

Sand and silicates	88.54
Alumina	3.11
Oxide of iron	2.15
Lime	.68
Magnesia	.30
Potash	.92
Soda	.26
Sulphuric acid	.15
Phosphoric acid	.14
Organic matter containing .06 Nitrogen	2.82
Water	.41

Capillary capacity for water, 38.40.

No. 35.—Bay City, Bay Co.

Selected by Judge Marston.
Timber: Not stated.

Sand and silicates	82.24
Alumina	4.60
Oxide of iron	2.42
Lime	1.18
Magnesia	.46
Potash	1.18
Soda	.54
Sulphric acid	.20
Phosphoric acid	.38
Organic matter containing .17 nitrogen	5.57
Water	.25

Capillary capacity for water, 47.30.

No. 36.—Greenville, Montcalm Co.

Timber: Not stated.

Sand and silicates	85.40
Alumina	4.50
Oxide of iron	2.80
Lime	.82
Magnesia	.31
Potash	1.13
Soda	.45
Sulphuric acid	.21
Phosphoric acid	.20
Organic matter containing .10 nitrogen	2.75
Water	1.43

Capillary capacity for water, 37.80.

No. 37.—Gaylord, Otsego Co.

Selected by S. H. Crowl.
Timber: Maple, Beech, Hemlock, Basswood, etc.

Sand and silicates	91.92
Alumina	2.93
Oxide of iron	.90
Lime	.40
Magnesia	.13
Potash	.61
Soda	.28
Sulphuric acid	.10
Phosphoric acid	.14
Organic matter containing .07 nitrogen	2.20
Water	.39

Capillary capacity for water. 39.60.

No. 38.—Tawas, Iosco Co.

Selected by J. A. F. Scheffler.
Timber: Hemlock, Pine, Beech and Maple.

Sand and silicates	80.06
Alumina	7.15
Oxide of iron	3.53
Lime	.93
Magnesia	.36
Potash	1.10
Soda	.38
Sulphuric acid	.19
Phosphoric acid	.16
Organic matter containing .09 nitrogen	4.59
Water	.82

Capillary capacity for water, 63.80.

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